AbstractID: 1725 Title: Normalized Dose Difference (NDD): A Simple Method for Dose Distribution Comparison

When comparing a test (usually calculated) (1D, 2D, 3D) dose distribution with a reference (usually measured) dose distribution, a dose difference map is not enough, since a small spatial error in high dose gradient regions results in an exaggerated large dose difference. Low et al[1] have developed a method to calculate a parameter called the γ -index, which represents the minimum distance in the dose-distance space. While the index indicates if the calculated distribution meets the pre-set acceptance criteria at every calculation point, it does not tell quantitatively how much the calculation differs from the reference. In the present work, we introduce a new concept called normalized dose difference (NDD) distribution to resolve the above issue. This quantitative method for dose comparison utilizes the dose gradient information and is defined as $NDD(\vec{r}) = \left[D_t(\vec{r}) - D_r(\vec{r})\right] \Big/ \max\left\{1, \frac{1}{\alpha}\left|\vec{\nabla} D_r(\vec{r})\right|\right\}$, where $D_t(\vec{r})$ is the test dose distribution, $D_r(\vec{r})$ is the reference dose distribution, α is called dose-spatial error equivalence factor and $\alpha = |\delta D| / |\delta \vec{r}|$ with dose error $|\delta D|$ and spatial error $|\delta \vec{r}|$ being equivalently important in dose comparison. This method has been tested in various situations. In accordance with the definition, in low dose gradient areas, NDD is the same as the absolute dose difference. However, in high dose gradient regions, such as regions close to the target edge, the dose difference is automatically normalized and thus yields a realistic estimation of dose error. This simple method can be easily implemented and will be a useful tool for dose comparison.

Low, et al. Medical Physics, 25:656-661, 1998.